

Missoula County PM_{2.5} Nine Factor Analysis

November 30, 2007

1. Introduction

In December of 2006, the United States Environmental Protection Agency (US EPA) promulgated new standards for particulate matter 2.5 microns or smaller (PM_{2.5}). This new standard lowered the permissible 24 hour level of PM_{2.5} from 65 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) to 35 $\mu\text{g}/\text{m}^3$. Based on monitoring results from 2004-2006, Missoula is likely to be found in non-attainment of this new standard. If the US EPA determines Missoula is not meeting the federal standard based on monitoring results from 2004-2007, it will designate either the county or a portion of the county as a PM_{2.5} non-attainment area.

The US EPA uses 9 criteria, or factors, to determine the appropriate size of a non-attainment area. States must submit an analysis of these 9 factors, along with a proposed non-attainment boundary, for any areas that are not meeting the federal standard. Because the Missoula Air Pollution Control Board has been designated as the lead planning agency for Missoula County air quality, the Missoula Health Department prepared an analysis of the 9 factors and the Board adopted a proposed boundary to forward to the Montana Department of Environmental Quality (DEQ) on November 15, 2007. DEQ will review the proposal to ensure it meets federal requirements, and will submit Missoula's proposal to the Governor, along with a proposed separate non-attainment boundary for Ravalli County. By law, the Governor has to submit proposed non-attainment boundaries with supporting documentation to the US EPA by December of 2007. The US EPA is required to make the final non-attainment area designations by December of 2008.

The US EPA guidance for PM_{2.5} designations dated June 8th 2007 lists the 9 factors that must be addressed to determine the size of a proposed PM_{2.5} non-attainment area:

1. Emissions in areas potentially included versus excluded from the non-attainment area
2. Air quality in potentially included versus excluded areas
3. Population density and degree of urbanization including commercial development in included versus excluded areas
4. Traffic and commuting patterns
5. Growth rates and patterns
6. Meteorology (weather/transport patterns)
7. Geography/topography (mountain ranges or other air basin boundaries)
8. Jurisdictional boundaries (e.g., counties, air districts, Reservations, etc.)
9. Level of control of emission sources

Since Missoula is currently meeting the annual PM_{2.5} standard and failing to meet the 24-hour PM_{2.5} standard, this document focuses only on issues related to the 24-hour

standard. The proposed non-attainment area boundary is given below in section 2. It is described using township, range and sections, based on the Public Land Survey System (PLSS) in order to maintain consistency with the description of other air quality boundaries (PM₁₀, Carbon Monoxide, Air Stagnation Zone, and High Impact Zone M) within Missoula County. The use of the PLSS also allows for greater precision in selecting areas that will be included or excluded from the non-attainment area than the use of larger Universal Transverse Mercator (UTM) grids.

2. Proposed Non-attainment Area

The proposed non-attainment area includes approximately 891 square miles as described below and shown in Figures 1 and 2.

Township	Range	Sections
16N	24W	1,12
16N	23W	1-36
16N	22W	19-21, 28-34
15N	23W	1-14, 23, 24
15N	22W	1-30, 32-36
15N	21W	1-36
15N	20W	3*, 4*-9, 15*, 16*-23*, 25*-36*
14N	22W	1-5, 8-17, 22-27, 34-36
14N	21W	1-36
14N	20W	1*, 2-36
14N	19W	5, 6*, 7-8, 13-36
14N	18W	15-22, 27-34
13N	22W	1-3, 10-15, 22-27, 34-36
13N	21W	1-36
13N	20W	1-36
13N	19W	1-36
13N	18W	2-11, 14-23, 26-36
13N	17N	31
12N	22W	1-36
12N	21W	1-36
12N	20W	1-36
12N	19W	1-36
12N	18W	1-36
12N	17W	3-10, 14-36
12N	16W	19, 25-36
11N	22W	1-3, 10-15, 22-27, 34-36
11N	21W	1-36
11N	20W	1-36
11N	19W	1-36
11N	18W	1-36
11N	17W	1-36
11N	16W	1-12

*Excepting areas included in the Flathead Reservation

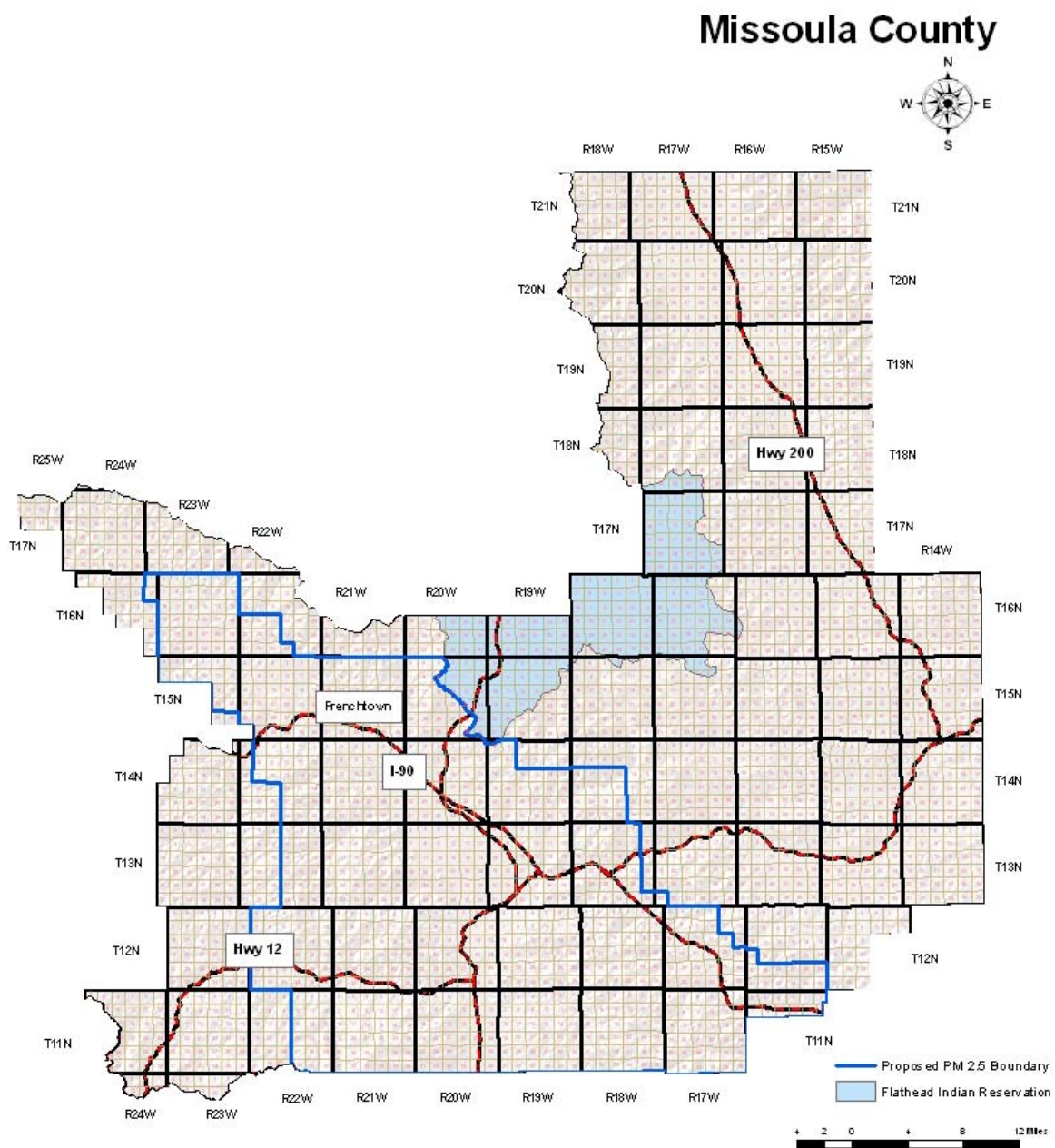


Figure 1. Map showing the boundaries of the proposed PM_{2.5} non-attainment area.



Unless otherwise noted, samples are collected every 3rd day at a monitoring site. Typically, Missoula violates the 24 hour PM_{2.5} standard a few times each year, generally during the winter months. In fact, all of the recorded exceedance days (with the exception of exceedances due to wildfire smoke) for 2001-2006 occurred in November, December, or January. Data shown in Tables 1 & 2 below were collected using equipment located on the roof of the Missoula City-County Health Department near downtown Missoula.

2001		2002		2003		2004		2005		2006	
Date	µg/m ³	Date	µg/m ³	Date	µg/m ³	Date	µg/m ³	Date	µg/m ³	Date	µg/m ³
1/10	47.9	1/11	32.4	1/24	41.6	1/16	62.3	1/19	62.5	11/28	43.2
1/19	45.4	11/28	29.2	11/8	32.9	1/10	55.4	12/12	54.0	12/10	36.2
1/13	43.7	11/25	24.8	12/2	27.1	1/19	46.8	12/9	42.5	8/30¹	34.3 ¹
1/4	42.9	11/22	23.0	8/25	24.9	12/17	36.6	8/8	30.8	12/22	31.5
1/1	34.9	11/4	20.8	8/10	24.7	2/15	30.8	1/16	30.8	12/7	26.2

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Table 2. Missoula's Running 24-Hour PM_{2.5} Standard Design Values¹

(Based on three year average of yearly 98th percentile 24-hr values)

2001 – 2003 µg/m³	2002 – 2004 µg/m³	2003 – 2005 µg/m³	2004 - 2006 µg/m³
32	33	39	41

¹24-hour PM_{2.5} Standard Design Values over 35 exceed the national ambient air quality standard.

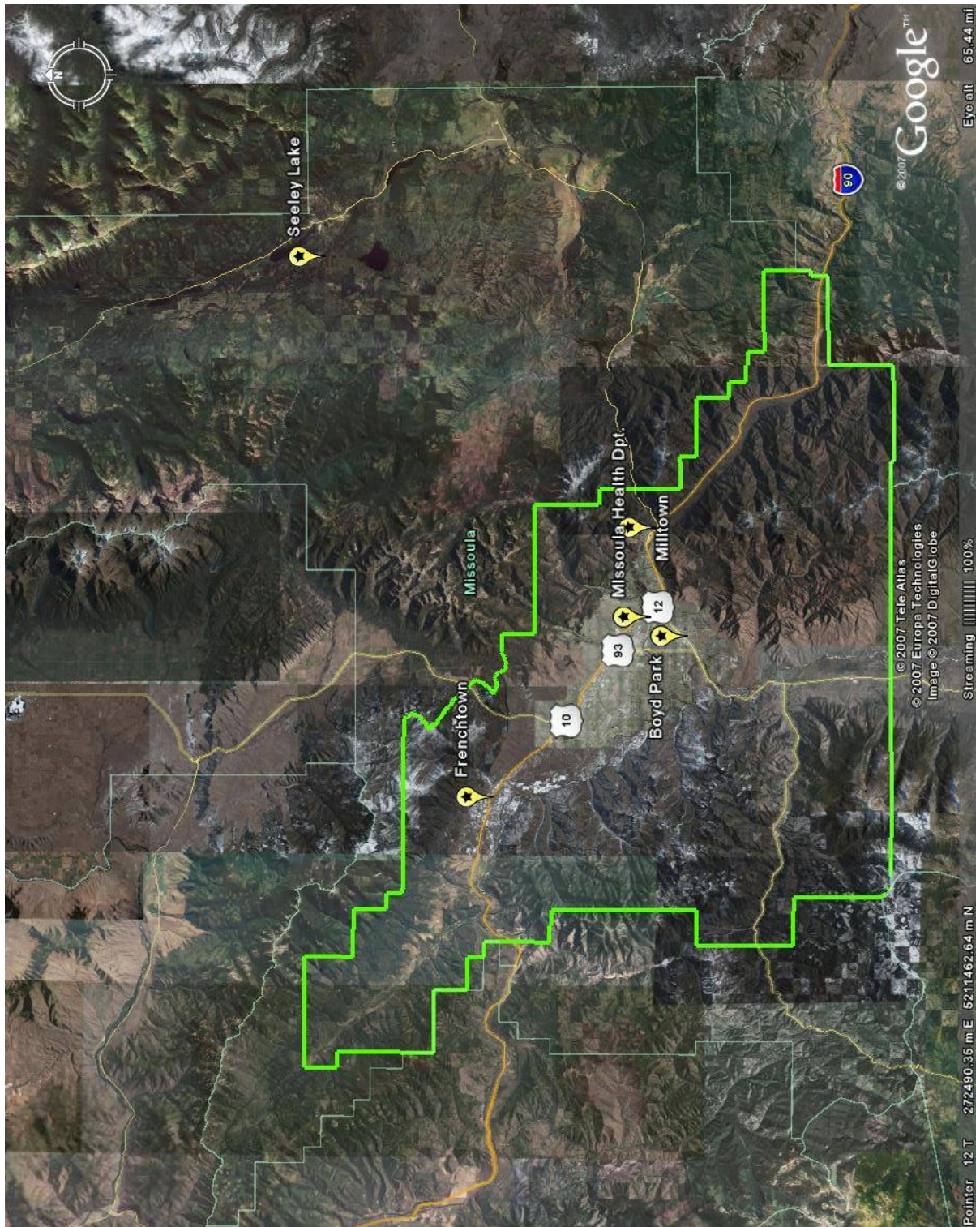


Figure 3. Map showing the location of monitoring sites in Missoula County at Frenchtown, Boyd Park in Missoula, Milltown, and Seeley Lake.

4. Nine Factor Analysis

1. Emissions in areas potentially included versus excluded from the non-attainment area.

A chemical mass balance (CMB) study was recently completed to help determine the sources of fine particulate pollution within the Missoula area. A graph representing the results of this study may be seen in Figure 4. This study used a Chemical Mass Balance (CMB) computer model to apportion the sources of the fine fraction, where information on the PM_{2.5} chemical composition and anticipated sources in the Missoula Valley served as model inputs. Ambient air sample data collected every three days from November 1, 2006 through February 27, 2007 from the PM_{2.5} chemical speciation sampler (SASS) was used for the model. In addition, a Federal Reference Method (FRM) PM_{2.5} sampler was collocated with the speciation sampler. The FRM sampler collected samples of the ambient air on quartz filters on the same sample days.

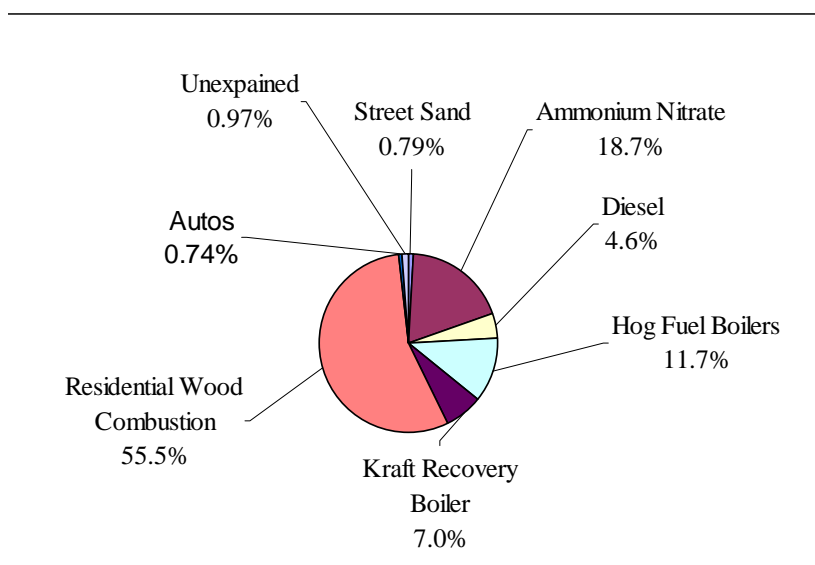


Figure 4. Graph showing results of the chemical mass balance (CMB) study conducted in Missoula during the winter of 2006-2007 showing the relative contributions from several sources to total PM_{2.5} pollution.

The CMB study showed that in the winter, the major source of PM_{2.5} pollution is residential wood burning. Additionally, a Missoula residential wood burning survey was conducted in 1996. It assessed woodstove and fireplace use in a 288 square mile grid, approximately 100 square miles larger than the Air Stagnation Zone (ASZ) (Figure 7), but smaller than the proposed PM_{2.5} non-attainment boundary. That study concluded that 19.64% of all residences burned wood. DEQ extrapolated those numbers for a 2000 carbon monoxide emission inventory and concluded that in the ASZ where strict woodstove regulations apply, 17.62% of the households burn wood.

In the ASZ, regulations prohibit the installation of new woodstoves or fireplaces and require most woodstoves be removed when the house is sold. Given these provisions, it

is reasonable to expect that the number of homes in the ASZ with stoves has continued to decrease, even as the number of housing units has increased. However, the Air Stagnation Zone, encompassing 188 square miles, only comprises 21% of the proposed non-attainment area. Houses and businesses in the remaining 79% of the proposed area have not been subject to residential wood burning device regulations. Thus, it is reasonable to expect that a higher percentage of the homes outside the ASZ burn wood than within it.

With the exception of the Seeley Lake area, relatively few homes and residents are located in areas not proposed for inclusion in the non-attainment boundary. For example, extending the non-attainment area to the extreme northwest end of the Nine Mile Valley (adding over 100 square miles in this area) would add fewer than 20 residents, many of which may only be seasonal. In fact, it has been noted by staff at the Missoula County Office of Planning and Grants that the proposed non-attainment area encompasses 93% of the current county population. (See Factor 3 for more information.) However, even if a higher percentage of these excluded homes use woodstoves, their relative contribution of PM_{2.5} is insignificant given their small number.

The CMB study showed that another significant source of PM_{2.5} emissions is industry. All major Missoula County industrial PM_{2.5} point sources, excluding Pyramid Mountain Lumber in Seeley Lake, are in the proposed PM_{2.5} non-attainment area (Figure 5). These industrial point sources include: Smurfit-Stone Container, Stimson Lumber and Roseburg Forest Products. The other major industrial sources, which are included in Table 8 below, are not significant PM_{2.5} contributors.

All of the county's smaller industrial point sources are located in the proposed PM_{2.5} non-attainment area. These small industrial sources include a bulk portland cement transfer station, a paper incinerator, two animal crematoriums and two crematoriums.

Portable industrial sources such as concrete plants, asphalt plants and gravel crushers are generally closed November through February and thus are insignificant sources of PM_{2.5} during winter inversion conditions (when air pollution problems most often occur). Additionally, most of these portable sources operate in the proposed PM_{2.5} non-attainment area, where most county construction and road building activities occur.

The only significant industrial PM_{2.5} source outside the proposed non-attainment area is Pyramid Mountain Lumber in Seeley Lake. The mountain chains and distance between Seeley Lake and Missoula (~32mi over land, or ~52mi via road) create separate air sheds that should be considered independently. Because there are many air pollution control regulations in the Missoula valley and relatively few controls in Seeley Lake, the sources of PM_{2.5} pollution are quite different between the two sites. Moreover, a PM_{2.5} sampling station is operating within Seeley Lake, and thus any violations of the PM_{2.5} standard occurring in that area will be detected. For all these reasons, neither Seeley Lake nor the Swan Valley is included in the proposed PM_{2.5} non-attainment area.

Another major contributor to winter PM_{2.5} emissions is transportation, which is discussed in greater detail under Factor 4, Traffic and Commuting Patterns. In general, most of the vehicle emissions will occur within the proposed non-attainment area boundary, which includes major traffic corridors as well as the entire Missoula urban area and surrounding communities.

Many areas within the proposed non-attainment area are under public ownership (including US Forest Service and US Bureau of Land Management), and thus not likely to be developed for industrial uses, travel, or dwellings (Figure 6). In addition, the steep gradient of the hills and mountains surrounding the urban area make these locations unsuitable for widespread future development. Many of these publicly held lands excluded from the proposed boundary to the west and northwest are classified by the US Forest Service as either:

- 1) “large, roadless blocks of land distinguished primarily by their natural environmental character managed to provide for a wide variety of dispersed recreation activities in a near-natural setting and for old-growth dependent wildlife species; classified as unsuitable for timber production” or
- 2) “of varying physical environments which are classified as suitable for timber production; management provides for healthy stands of timber and optimizing timber growing potential and sustained timber production”

and thus are not likely to be developed for mining, ski resorts, or grazing. As such, these areas are unlikely to represent a significant source of PM_{2.5} emissions. In addition, the US Forest Service participates in the Montana/Idaho Airshed Group’s Smoke Monitoring Unit, which coordinates the amount of prescribed burning that takes place in a given airshed at a given time. This way, smoke impacts from forestry practices are greatly reduced.

Generally, outdoor burning from public and private lands is not a significant contributor to PM_{2.5} exceedances, due to the closure of the burning season December 1-February 28.

In summary, with the exception of Seeley Lake, which is located in a separate airshed, areas excluded from the proposed non-attainment area have no major industrial sources, and few sparsely distributed area sources of PM_{2.5} or precursor emissions.

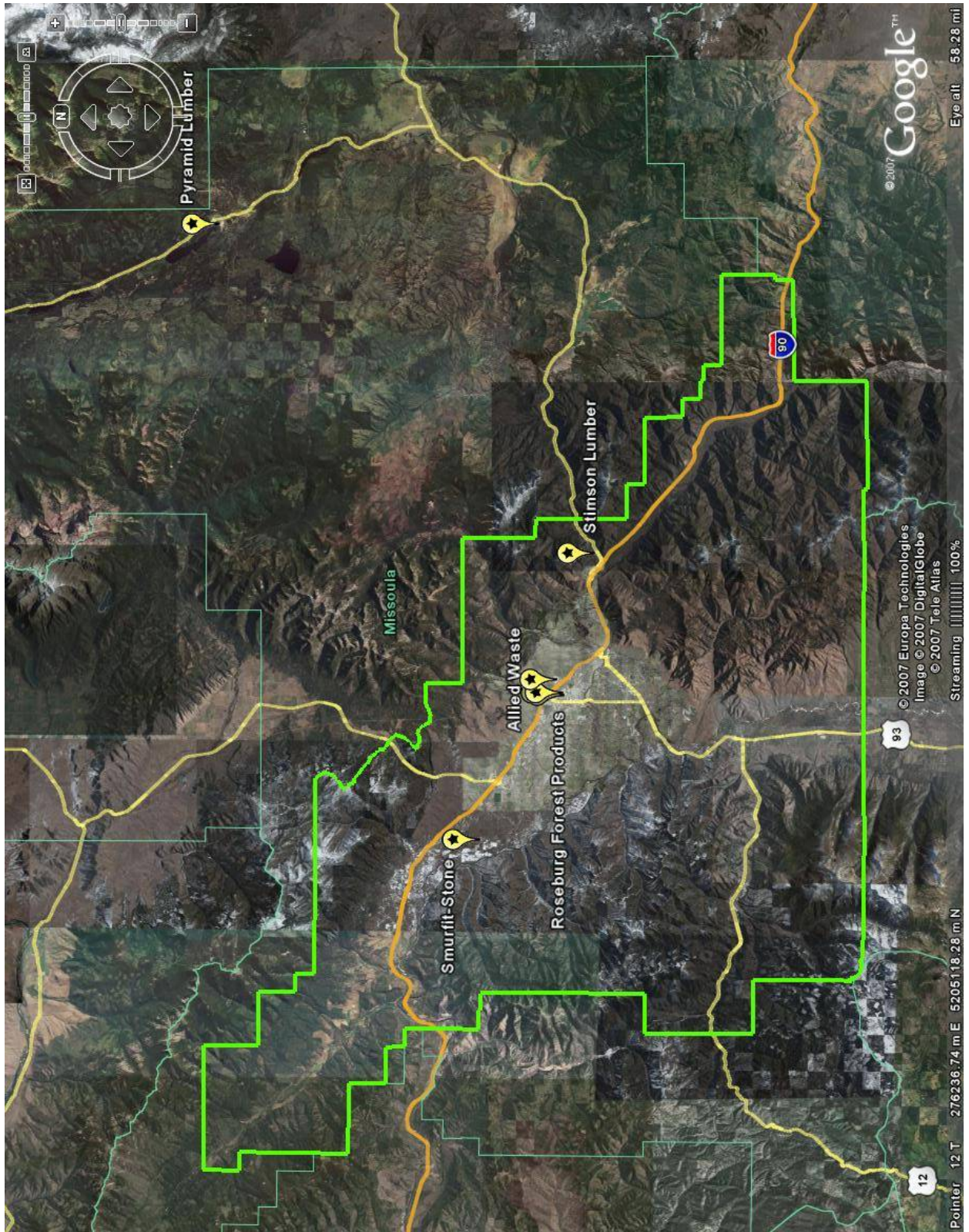


Figure 5. Location of major Industrial Point Sources in Missoula County in relation to the proposed PM_{2.5} non-attainment area. The cluster of sources at the north end of Missoula includes Roseburg, Hexion, ConocoPhillips, and Allied Waste.

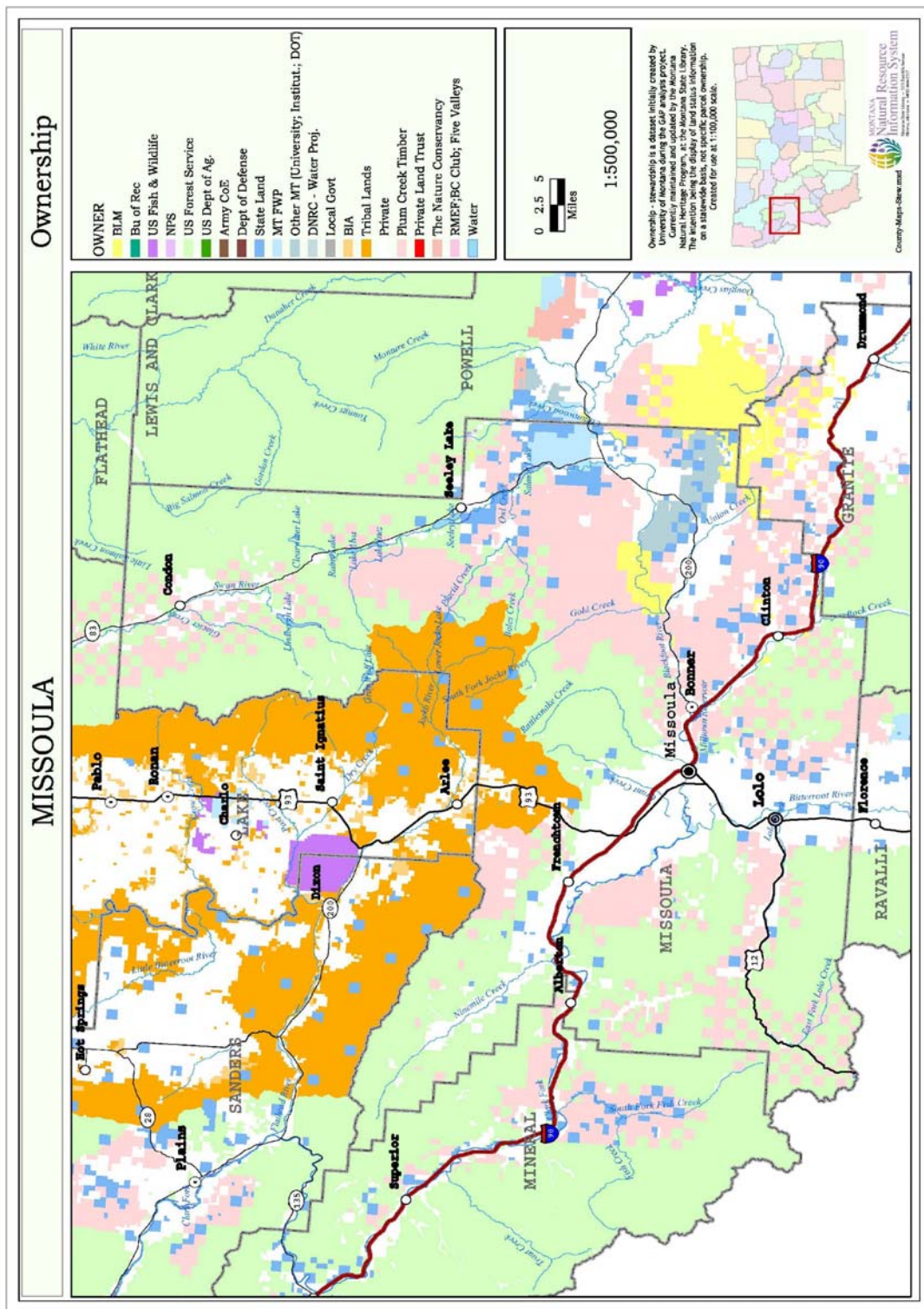


Figure 6. Map of Missoula County showing ownership of different areas of the county.

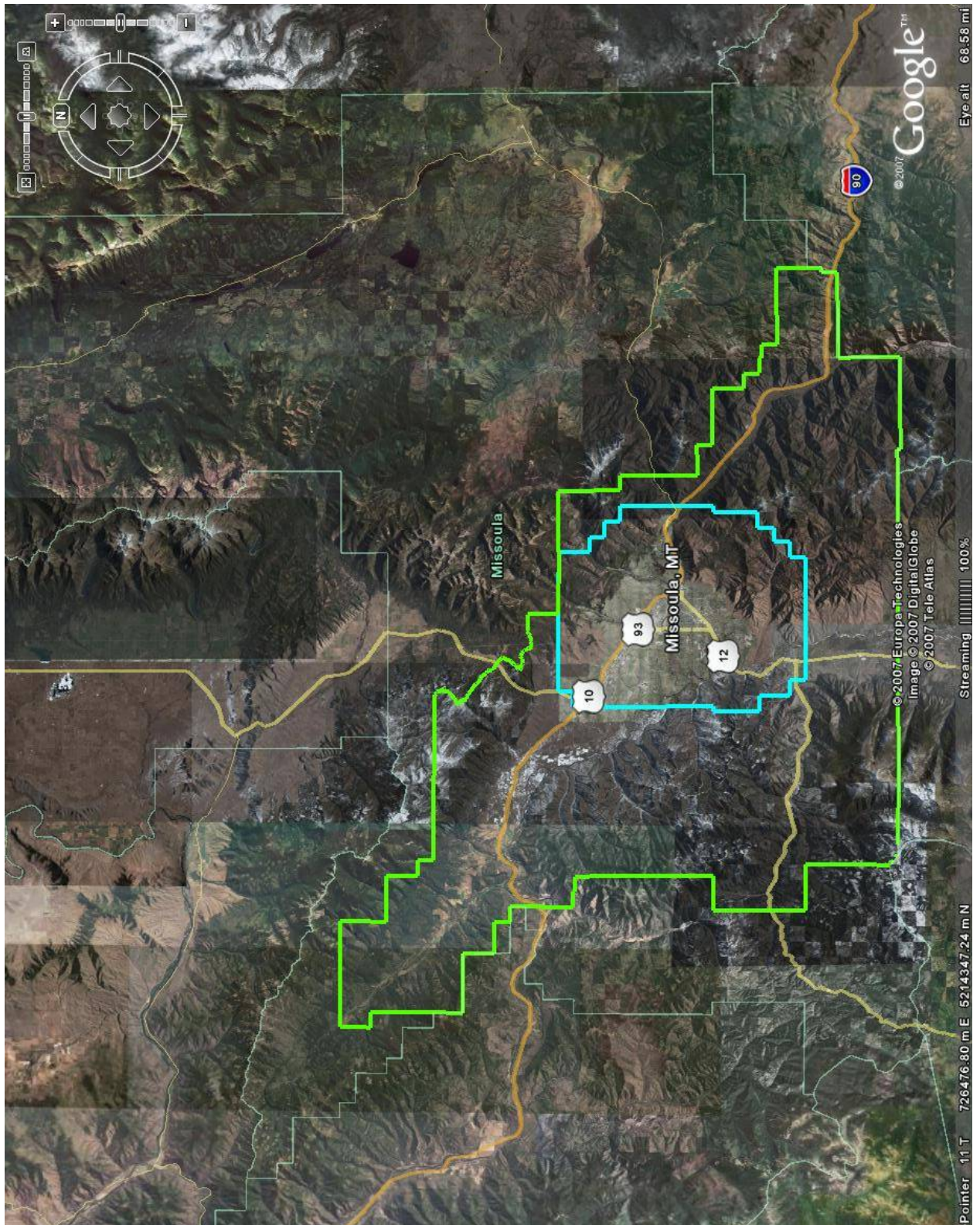


Figure 7. Map showing the Air Stagnation Zone (blue) in relation to the Missoula Valley and the proposed PM_{2.5} non-attainment area.

Table 8. Major Industrial Point Sources in Missoula County

	2004						2005						2006							
Industrial Source	CO	NO2	SO2	VOC	PM2.5	CO	NO2	SO2	VOC	PM2.5	CO	NO2	SO2	VOC	PM2.5	CO	NO2	SO2	VOC	PM2.5
Smurfit-Stone	3442.3607	1601.6784	177.3555	308.9958	165.7821	1483.2640	817.9545	83.8650	115.7406	185.4931	1611.7894	851.1171	63.3837	123.9257	148.3664					
Roseburg	87.7845	495.2933	7.5353	19.0705	N/A	84.7720	473.9499	7.1546	19.4271	N/A	72.5662	354.4402	5.5281	17.4160	N/A					
Stimson	301.6556	210.5861	11.2643	119.2923	109.3383	233.9958	163.4846	8.7488	88.5205	128.4837	268.9678	187.9650	10.0602	99.6269	119.0587					
Hexion	0.5985	2.8500	0.0171	7.0314	N/A	0.4515	2.1500	0.0129	7.1057	N/A	0.3885	1.8500	0.0111	5.6290	N/A					
ConocoPhillips	20.0800	8.0300	N/A	67.9430	N/A	19.7500	7.9000	N/A	63.1110	N/A	19.9100	7.9600	N/A	65.1155	N/A					
Allied Waste	3.4133	4.7036	2.5142	1.7066	1.4277	3.4727	4.7856	2.5579	1.7364	1.4526	3.4830	4.7997	2.5655	1.7415	1.4569					
Pyramid	21.5762	3.9913	0.4979	50.1777	27.8460	20.7369	3.3837	0.4568	46.2246	26.4573	20.8119	3.2205	0.4501	45.4397	25.8798					
Total	3877.4688	2327.1327	199.1843	574.2173	304.3941	1846.4429	1473.6083	102.7960	341.8659	341.8867	1997.9168	1411.3525	81.9987	358.8943	294.7618					
Percent of Total w/in proposed boundary	99.44%	99.83%	99.75%	91.26%	90.85%	98.88%	99.77%	99.56%	86.48%	92.26%	98.96%	99.77%	99.45%	87.34%	91.22%					

2. Air quality in potentially included versus excluded areas.

While there is a lack of monitoring data for many areas of the county, results from permanent and temporary monitoring sites, when used in concert with the other factors, help define which areas should be included in the non-attainment area.

Monitoring data collected in 2000-2001 shows that the community of Frenchtown to the west of the Missoula urban area has very similar PM_{2.5} values to Missoula (Table 4), and therefore must be included in the non-attainment boundary. The community of Huson, even further west, is a much smaller community but is located in the same valley. Therefore PM_{2.5} values are likely to be similar there as well.

The Health Department also conducted PM_{2.5} sampling in Milltown, east of the urban area, from 2002 to 2004 (Tables 5 and 6). PM_{2.5} levels collected from that site were slightly lower than those found in Missoula. This result follows given that the sampled portion of the county to the east is located topographically upgradient of the urban area.

The Department has not conducted sampling in the Lolo area, south of the Missoula urban area toward Ravalli County. This community is also located topographically upgradient from the urban area, in the Bitterroot River valley. Based on the size of the community, its lack of industrial sources, and its upgradient location, air quality is likely better in Lolo than in the Missoula urban area.

To the north, the Department is conducting monitoring in Seeley Lake. While a limited amount of data has been collected to date, making a robust analysis of PM_{2.5} levels in Seeley Lake difficult, the available data shows that no correlation exists between levels of PM_{2.5} in Missoula and the levels collected from Seeley Lake.

Based on topography and limited sources of winter time PM_{2.5}, the northwestern portion of the Nine Mile area (to the extreme northwest of Frenchtown) should be excluded from the non-attainment area. The proposed boundary encompasses the majority of private lands located in the Nine-Mile valley to the northwest of Frenchtown. To the east areas encompassing both Milltown and points beyond Turah will need to be included in any non-attainment area based on 2002-2004 monitoring data (Tables 5 and 6), and are both within the proposed non-attainment area.

It is reasonable to assume that PM_{2.5} concentrations and PM_{2.5} emissions in areas outside the proposed non-attainment area will be significantly lower due to minimal population numbers, generally higher elevations, steep topographical gradients limiting population growth over much of the excluded area, and a general lack of point or area PM_{2.5} sources. Also, PM_{2.5} levels over 35 µg/m³ mostly occur during winter time inversions when pollution is trapped near the valley floors (10-30 meters) resulting in lower PM_{2.5} concentrations at higher elevations. According to the Montana Air Pollution Study (1980), wintertime inversions in the Missoula area range from 3 to 820 feet thick, and are based at 331 to 1640 feet above the valley floor. The proposed boundary includes areas that are below 4000 feet elevation, which includes areas from 600 to over 800 feet above

the valley floor, thus encompassing areas likely to be impacted by these inversions, as well as areas with significant sources contributing the majority of the PM_{2.5} emissions.

The data shown in Tables 3 & 4 was collected from March of 2000 to March of 2001 for a special study conducted by researchers from the University of Montana. The data show that the levels of PM_{2.5} collected from the Frenchtown area correlate strongly with PM_{2.5} levels collected from Missoula.

Table 3. Frenchtown¹ 24-Hour High PM_{2.5} Values from 2000-2001 CMB Study

2000: March-December		2001: January-March	
Date	µg/m³	Date	µg/m³
12/23	55.3	1/4	57.0
11/17	17.1	2/21	49.3
10/24	15.8	3/5	19.3

¹Frenchtown study samples collected every 12th Day. In Frenchtown there are no woodstove regulations, deicer is not used on the streets and many roads are unpaved.

Table 4. Missoula-Frenchtown High Daily PM_{2.5} Value Comparison

Date	Boyd Park-Missoula µg/m³	Health Department µg/m³	Frenchtown µg/m³
12/23/00	48.4	53.1	55.3
1/4/01	42.3	42.9	57.0
2/21/01	37.0	No Data	49.3
3/5/01	20.6	11.4	19.3

The data shown in Tables 5 & 6 was collected from August of 2002 to September of 2004 for a special study by the Missoula City-County Health Department. The data show that the levels of PM_{2.5} collected from the Milltown area to the east of Missoula are not significantly correlated with PM_{2.5} levels collected from the Missoula Valley.

Table 5. Milltown 24-Hour High PM_{2.5} Values

2002: Aug.-December		2003		2004: January-Sept.	
Date	µg/m³	Date	µg/m³	Date	µg/m³
11/16	25.8	8/10	29.0	1/16	49.1
10/26	21.7	8/25	27.1	1/19	42.9
11/25	19.8	1/24	26.6	1/13	37.1
11/7	19.5	12/2	25.4	1/10	24.4
12/22	18.4	11/8	22.9	1/7	22.5

Table 6. Missoula-Milltown High Daily PM_{2.5} Value Comparison

Date	Missoula Health Department µg/m ³	Milltown µg/m ³
1/24/03	41.6	26.6
11/8/03	32.9	22.9
12/2/03	27.1	25.4
8/25/03	24.9	27.1
8/10/03	24.7	29.0
1/16/04	62.3	49.1
1/10/04	55.4	24.4
1/19/04	46.8	42.9
1/13/04	No Data	37.1
2/15/04	30.8	13.2
1/7/04	29.8	22.5

The data shown in Table 7 was collected from 2005 to 2006 by the Missoula City-County Health Department. The Seeley Lake sampling site was recently moved, and sampling at this location is currently underway. The available data show that the levels of PM_{2.5} collected from the Seeley Lake area are not significantly correlated with PM_{2.5} levels collected from the Missoula Valley.

Table 7. Seeley Lake High PM_{2.5} Values

2005-Partial Year		2006	
Date	µg/m ³	Date	µg/m ³
12/15	25.1	12/7	39.4
12/21	24.1	1/5	38.3
11/18	24.1	1/2	32.1
11/30	22.9	2/4	24.9
12/27	21.4	1/19	22.2

3. Population density and degree of urbanization including commercial development in included versus excluded areas.

Missoula is the only city in Missoula County; none of the other population centers are incorporated, nor are they very large. The city of Missoula is situated in the middle of the proposed non-attainment boundary and covers 26 square miles. Over 63% of the population lives within the city with a density of almost 2400 persons per square mile. Surrounding the city is an urban area comprising an additional 26 square miles. Together the city and urban area house over 76% of the county's population.

Missoula County has several communities that are situated along the major travel corridors. Most of these centers are included in the proposed non-attainment area. The included communities include Frenchtown and Huson to the west; Lolo to the south; and

Bonner/Milltown/West Riverside and Clinton to the east. Of these, Lolo is the largest with a population of approximately 3400 people and a density of 356 persons per square mile. The Bonner/West Riverside area is the most densely populated at about 1091 persons per mile.

All told, the Missoula Office of Planning and Grants estimates that the proposed non-attainment boundary includes over 93% of the county's population.

Communities not included in the proposed non-attainment area are Evaro, which is on the Flathead Indian Reservation to the north of the urban area and those communities in the Blackfoot and Clearwater River drainages to the northeast. For the latter communities, Seeley Lake is the most populated at about 1450 persons.

Table 9. Total population and population density of the City of Missoula and unincorporated towns within Missoula County.

Area	Total Area in mi²	Total Population	Persons per mi²
Missoula County	2618.34	101,417*	39.0*
Missoula	23.91	64,081*	2397.1
Lolo	9.72	3388	356.2
Bonner/W. Riverside	1.66	1693	1091.6
Frenchtown	3.28	883	271.8
Seeley Lake	11.03	1436	131.8
Evaro	17.03	329	19.3

* 2006 US Census estimated population. All other data is from the 2000 U.S. Census.

Most commercial development is centered in the Missoula urban area. Smaller communities also have some small businesses and a few large industries. With the exception of the Seeley Lake area, all of the concentrated commercial development is included in the proposed non-attainment boundary.

Topography, access to services, existing transportation corridors, and availability of electrical service and potable water have played a significant role in how Missoula County has developed. The following series of maps (Figure 8) show that development has generally occurred in the Missoula urban area and along the river valleys.

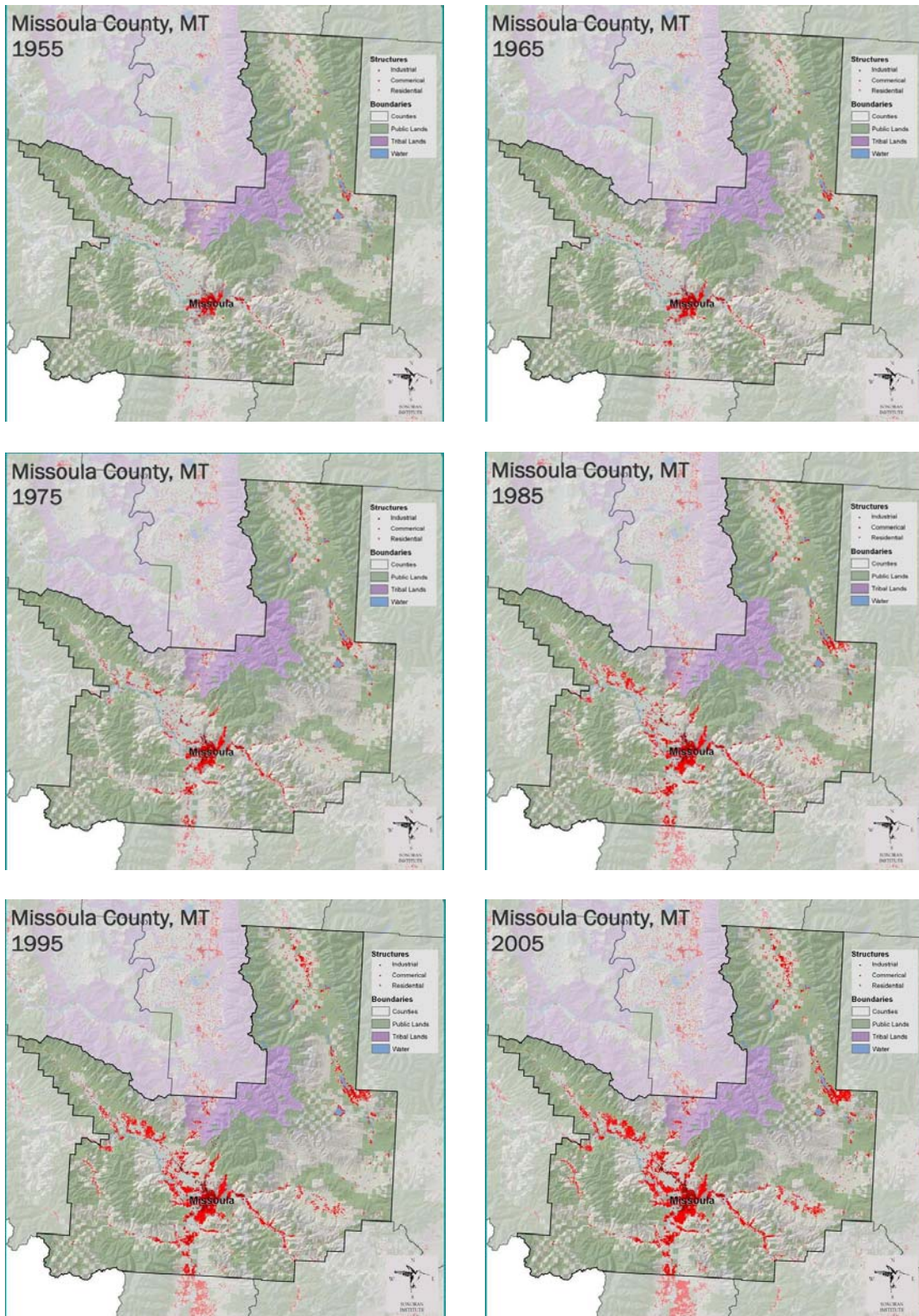


Figure 8. Maps showing the growth patterns of Missoula County from 1955-2005. Red areas indicate areas of growth (Industrial, Commercial, and Residential). Courtesy Sonoran Institute.

4. Traffic and commuting pattern.

The most significant traffic counts within the county are found along two corridors; one running roughly east-west along Interstate 90 (I 90) from Bonner to Frenchtown with the other running north to south from Missoula to the Ravalli county line (MDOT). Total traffic counts along the east to west corridor on I 90 exceed 30,600 total vehicles per day (totaling over 486,000 VMT), and over 4500 trucks daily. Total traffic counts along the north to south corridor are even higher with 36,184 total vehicles daily. Total VMT within the Missoula urban planning area (encompassing an area from just east of Frenchtown to Bonner, and from Evaro to just south of Lolo) was over 1,638,000 in 2000. Within Missoula city limits, VMT was 869,100 in 2000 and expected to grow over 40% by 2025 (2004 LRTP). In addition, according to the US Census Journey to Work database, 3178 workers travel from Ravalli County to Missoula County, and 900 workers travel from Missoula County to Ravalli County for employment. This is in comparison to the much larger number of within county commuters (11,766 workers that travel within Ravalli County, and 47,159 workers within Missoula County) that travel for employment.

Few areas within the county outside of the two corridors mentioned above have traffic counts in excess of 10,000 total vehicles per day, and most have below 5000 total vehicles per day (Figure 9). This is especially true in the more remote northern portions of the county, which experience total traffic counts of only 1100 to 1700 total vehicles per day (MDOT). All areas of Missoula County with traffic counts above 10,000 total vehicles per day, including the Highway 93 and I 90 corridors are within the proposed non-attainment area. Most areas with fewer than 2000 total vehicles per day are excluded from the proposed non-attainment area.

In addition, some of the largest increases in traffic counts are occurring to the west and to the south of Missoula, with smaller increases to the east. There was an 89% increase in traffic counts during 2004-2006 on Lower Miller Creek Road, just south of Missoula. During the same time, there was a 37% increase in traffic counts on S. 7th W, 300' east of Clements Road to the west of Missoula. There was a 20% increase in traffic counts on Spurgin Road 300' east of Clements Road, also to the west of Missoula. All of these roads are major collector roads, serving to connect growing neighborhoods with the larger arterial roadways in the urban area. To the east, there was an 8% increase on W. Riverside Dr. These increases are likely due to the increase in growth and settlement in these areas, and are likely to continue for the foreseeable future. These areas experiencing rapid traffic growth and the neighborhoods they serve fall within the proposed non-attainment area.

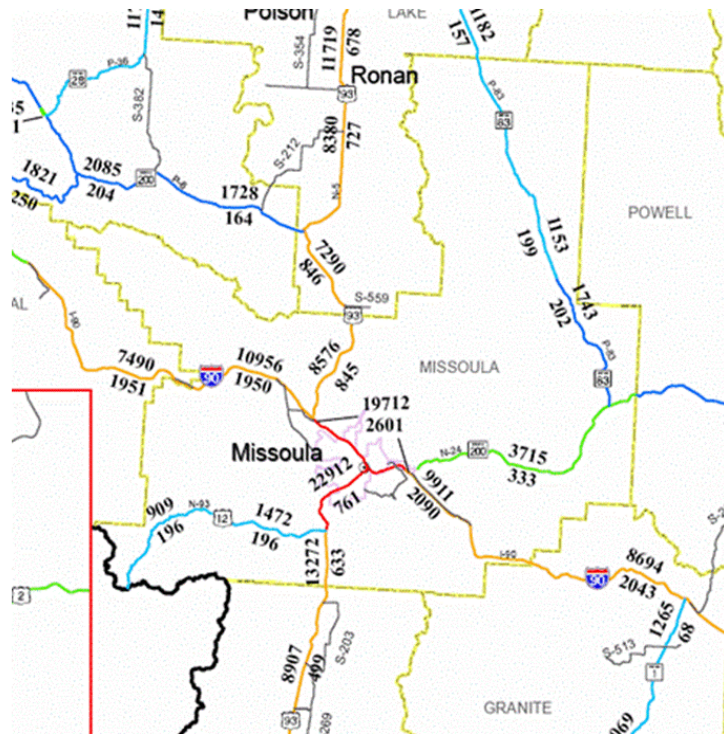


Figure 9. Map of Missoula County showing traffic counts on major highways throughout the county. Upper numbers refer to car counts, lower numbers refer to truck counts. (MT DOT)

5. Expected growth (including extent, pattern and rate of growth).

The unique topography, access to services, as well as availability of electric service and potable water within the Missoula area plays a significant role in determining the location of future development. As a result, most growth in the county is expected in the urban area (Figure 10), in and around Lolo to the south, and toward Frenchtown to the west. The Missoula County Office of Planning and Grants is currently in the process of mapping any additional areas of expected growth.

Growth trends can be demonstrated in several different ways. The first is by the number of acres subdivided between 1996-2004, with over 5300 acres being subdivided within the Missoula urban area, and over 2300 acres subdivided to the west, within the Frenchtown-Huson area. By comparison, the area with the next largest number of acres subdivided is the Seeley-Swan area to the north east of Missoula, with only 1400 acres subdivided during the same time. The second way this trend is demonstrated is by the number of individual lots subdivided within the county. Within the Missoula urban area, over 4900 lots were subdivided from 1996 to 2004. By comparison, the next highest number of subdivided lots was within the Lolo area, with 407 lots subdivided during the same time.

Missoula also attracts many new residents each year, given the proximity to many recreational areas within minutes of the city. The Missoula city population is expected to

grow at a rate of 1.3% per year (2004 LRTP). With this increase in population and development will likely be an increase in the number of vehicles and VMT, as well as an increase in the number of homes in the area. This growth in either population or services is not expected in the more remote areas of the county; as a result these areas should not be included in the non-attainment boundary.

Much of the land not included in the non-attainment area, with the exception of land in the Blackfoot and Clearwater drainages is under public ownership, is often very steep and is not likely to be developed either into residential or commercial uses.

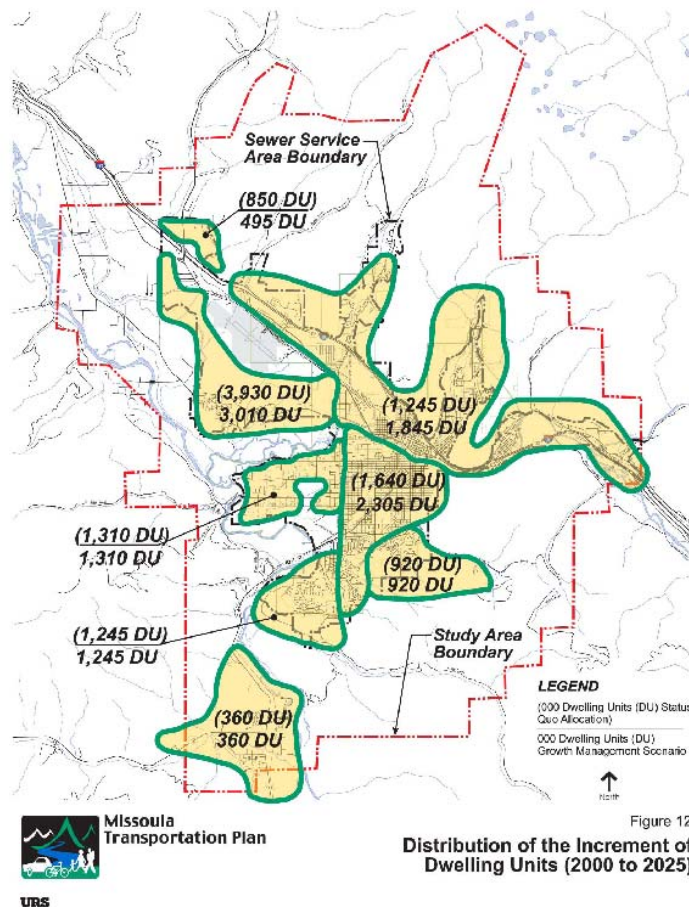


Figure 10. Expected increases in dwelling units and locations within Missoula County, showing areas of expected growth.

6. Meteorology (weather/transport patterns).

The average annual temperature of the Missoula area is 7.1°C (44.8°F), and the average annual precipitation is 35.1cm (13.8 inches) (National Weather Service).

The Missoula Valley is located west of the Continental Divide, has steep slopes limiting lateral dispersion, and is subject to intense and long lasting stagnation periods with strong persistent temperature inversions in the lower atmosphere. These stagnation periods are the root cause of the high PM_{2.5} ambient levels that have resulted in the non-attainment status of the Missoula Valley.

With the exception of summer forest fire impacts, all of the highest measured PM_{2.5} levels occur during the winter months when these inversions are the strongest and most persistent. The problematic winter inversions are surface based during the night and elevated during the day. The inversions are typically very strong (+ 3 °C/100m or more) for the lowest 200 meters of the atmosphere during the nighttime hours into the early morning. During the late morning and afternoon, the atmosphere near the surface becomes somewhat adiabatic or at least isothermal for the lower 200-300 meters allowing some vertical mixing, but an elevated inversion remains in place trapping the pollutants in the valley over a period of several days, allowing the particulate levels to steadily rise until a synoptic event flushes the air out of the valley. During the nighttime hours when the surface-based inversion is at its strongest, vertical mixing is almost nonexistent.

Smoke and other pollutants from area sources such as cars and woodstoves are trapped in a very shallow (10-30 meters) layer near the surface. This produces the characteristic “spike” of high PM_{2.5} concentrations during the nighttime hours and during the morning commute.

With the vertical mixing issue, lateral dispersion is also severely limited during this period with many hours of “calm” wind speeds recorded at the surface. Winds aloft are totally decoupled from the surface by the stable inversion layer and there is almost no net transport of air out of the valley. Under these conditions, even “regional scale” pollutants like PM_{2.5} with high residence times aloft become local issues with steep lateral concentration gradients as pollution stays very near the emission sources. Diurnal drainage flows are the only sources of air movement under these conditions and they do little to provide any net transport. The bottoms of the valley is relatively flat and, once minor flows reach the valley floor from the side canyons, downslope gravity winds are minimal.

Three big differences between the Bitterroot and Missoula Valleys are their size, shape and orientation. The Bitterroot is long, narrow, and oriented north/south. The Missoula valley is more bowl shaped with five drainages converging before exiting out to the northwest. The minor amounts of drainage flows reaching the Missoula Valley from the Bitterroot under inversion conditions are very shallow and skirt the west edge of Missoula Valley in the low terrain before heading out past Frenchtown through the Clark Fork River Canyon. This physical separation of air from the Bitterroot Valley from the city of Missoula is why the CMB results from the two areas are so dissimilar.

Such a transport scenario is demonstrated by the available air monitoring data for the area, showing increased concentrations of PM_{2.5} to the west of Missoula (Table 4), with lower concentrations found to the east (Table 6). Thus, it is highly unlikely that pollution

generated within the Missoula urban area would impact the Seeley Lake or Swan Valley areas to the north east. This supports the idea that a non-attainment boundary should focus on the city of Missoula and the immediate urban area, rather than the more remote parts of the county such as Condon or Seeley Lake.

7. Geography/topography (mountain ranges or other air basin boundaries).

Missoula is a city located in the Rocky Mountains of western Montana. The Missoula urban area, located at the confluence of several mountain valleys, contains over 76,431 people and is the largest urban area in the United States surrounded by the Rocky Mountains. In addition, the Missoula urban area is host to three rivers, including the Bitterroot, Clark Fork, and Blackfoot. Frenchtown lies to the northwest of Missoula, and the Bonner/West Riverside areas lie to the east (Figure 11).

The unique topography surrounding the Missoula area supports the creation of a non-attainment area that encompasses the Missoula urban area, while excluding the higher elevations and more remote parts of the county. The topography of Missoula County is one of the most significant factors influencing the air quality within the region. The surrounding mountains rise several thousand feet above the valley floor and act to confine the pollutants generated within Missoula to the city and the immediate area. Moreover, the surrounding mountains promote the formation of inversions in the winter (when the majority of PM_{2.5} exceedances occur), which act to trap pollution to the valley floor both within and around the Missoula area. As noted above, the mountains surrounding Missoula prevent the transport of pollution generated within the Missoula urban area to other outlying areas of the county.

Due to the lack of current development and limited potential for future development, there is a lack of PM_{2.5} sources (either point or area) from areas that are at higher elevations or within the more remote portions of the county. As such, any non-attainment area boundary need not include these steep slopes or remote areas.

8. Jurisdictional boundaries (e.g., counties, air districts, Reservations, etc.).

Given the nature of PM_{2.5} as a regional, rather than a localized pollutant, the Missoula County non-attainment area likely will, and should, extend southward from the Missoula urban area to the Missoula-Ravalli county line. While it is likely that the geographical area found in non-attainment of the 24hr PM_{2.5} standard will cover regions of both Missoula and Ravalli counties, any such non-attainment area should be divided at the boundary line between the two counties. This would effectively encompass the necessary region of non-attainment by creating two separate but adjacent non-attainment areas. The proposed Missoula County non-attainment area is contiguous with the proposed Ravalli County non-attainment area.

The creation of two separate but adjoining non-attainment areas would allow each county to implement the most effective and applicable strategies to reduce PM_{2.5} pollution for each individual county. This is especially important given the different source contributions of PM_{2.5} in each county (see figures 4 & 12), as well as the specific regulatory and political realities each county currently faces.

The different source contributions of PM_{2.5} in each county necessitates that steps to correct the violations differ as well. This would best be accomplished by each county individually, in that each county has the best understanding of the history of not only the air pollution within its boundaries, but possesses the best understanding of the political landscape within the county as well.

Missoula has a long history of addressing violations of the National Ambient Air Quality Standards for carbon monoxide (CO) and PM₁₀ and bringing the community into compliance. Consequently, Missoula has developed a strong air pollution program with extensive regulations (Missoula City-County Air Pollution Control Program, Revised 11-17-00) to reduce these pollutants. For example, in the mid 1980's, when it became clear that the increased use of woodstoves was a significant source of PM₁₀, it became illegal to install fireplaces or high particulate emitting wood stoves inside the Missoula Air Stagnation Zone. To further control woodstove emissions, it became illegal in 1994 to install any cordwood burning woodstove in the Air Stagnation Zone. In addition, high particulate emitting woodstoves are required to be removed from the property at the time the property changes ownership. The 2006-2007 chemical mass balance study shows that residential wood burning, while reduced from historic levels, continues to account for around 55% of winter time PM_{2.5} levels. Currently Missoula is a maintenance area for carbon monoxide (CO) and a non-attainment area for the 24hr PM₁₀ standard, but due to control measures that have been implemented, Missoula has not violated either standard since the early 1990's. It is of note that the non-attainment boundaries for both of these pollutants center on the city of Missoula, and do not include the more remote parts of the county.

In contrast, Ravalli County does not have an air pollution control program operating within the county, nor is the county currently out of attainment for any national air quality standard. Because Missoula and Ravalli counties have an extremely different air

quality history and perspective, the strategies and starting points to address the new PM_{2.5} 24hr standard will be different. However, while the forces at work within each county may be different in myriad ways, there are likely causes of PM_{2.5} pollution that are not only common to both counties, but are shared by both as well, such as transportation. It will thus be necessary for both counties to collaborate on measures aimed at controlling mobile sources of particulate pollution which travel between both counties. It is likely that the Montana DEQ will need to assume an active role to help facilitate collaboration between the two counties.

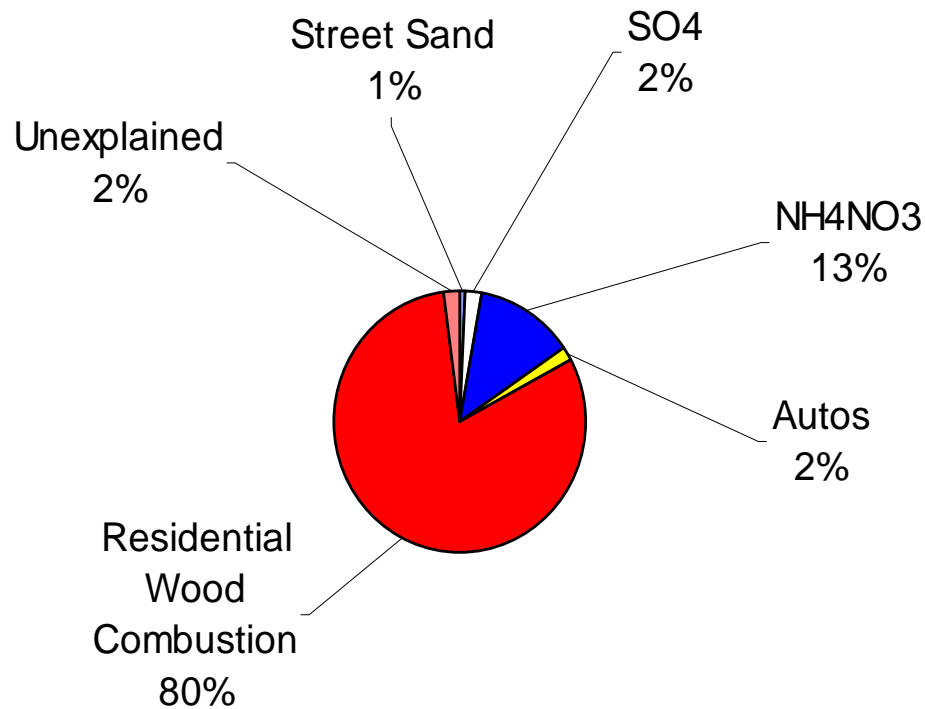


Figure 12. Graph showing draft results of the chemical mass balance (CMB) study conducted in Hamilton during the winter of 2006-2007 showing the relative contributions from several sources to total PM_{2.5} pollution.

9. Level of control of emission sources.

As noted above, Missoula County has a long history of air pollution control measures, necessitated by the quality of the air within the Missoula urban area, with exceedances for air quality standards beginning in 1969. The Missoula City-County Air Pollution Control program encompasses the entire geographic area of Missoula County including the Missoula urban area. Current areas of increased controls for PM₁₀ and CO fall within the boundaries of the proposed PM_{2.5} non-attainment area. These areas were created to control the sources of PM₁₀ and CO, and focus on the Missoula Air Stagnation Zone rather than the outlying areas of the county where there are few sources of PM₁₀ or CO. In addition, over 90% of the Missoula County population (Missoula County Office of Planning and Grants), and all major industrial point sources except for Pyramid Lumber (see #1 above) are within the proposed non-attainment area boundary.

The regulations and specific provisions of the program are adopted by the Missoula City-County Air Pollution Control Board, Board of Commissioners of Missoula County and the Missoula City Council. The air pollution control program is administered, implemented, and enforced by the Missoula City-County Air Pollution Control Board.

The current program is designed to control emissions from re-entrained road dust, open burning, residential wood burning, vehicle exhaust, incinerators, petroleum storage and other industrial sources. Although the program focuses on controlling particulate emissions, specific provisions of the program also control emissions of other pollutants including: sulfur dioxide, carbon monoxide, fluorides, volatile organic hydrocarbons, nitrogen dioxide, hazardous air pollutants, and odors. These regulations and programs have resulted in a marked improvement in Missoula's air quality. In fact, as noted above in #8, Missoula has not violated the carbon monoxide (CO) standard since 1992, and has not violated the PM₁₀ standard since 1989.